Journal Pre-proofs

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PII: S0306-4603(20)30660-2
DOI: https://doi.org/10.1016/j.addbeh.2020.106530
Reference: AB 106530

To appear in: *Addictive Behaviors Addictive Behaviors*

Received Date: 1 April 2020
Revised Date: 15 June 2020
Accepted Date: 25 June 2020

Please cite this article as: Z. Teng, H.M. Pontes, Q. Nie, G. Xiang, M.D. Griffiths, C. Guo, Internet Gaming Disorder and Psychological Well-being: A Longitudinal Study of Older-aged Adolescents and Emerging Adults, *Addictive Behaviors Addictive Behaviors* (2020), doi: https://doi.org/10.1016/j.addbeh.2020.106530

Internet Gaming Disorder and Psychological Well-being: A Longitudinal Study of Older-aged Adolescents and Emerging Adults

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Running Title: Internet Gaming Disorder and well-being

Funding sources: This study was supported by the Fundamental Research Funds for the Central Universities (grant numbers, SWU1909106, SWU1909566), the China Postdoctoral Science Foundation (grant numbers, 2018M640892), and the Chongqing Special Postdoctoral Science Foundation (grant numbers, XmT2018010).

Internet Gaming Disorder and Psychosocial Well-being: A Longitudinal Study of Chinese Older-aged Adolescents and Emerging Adults

Abstract

The American Psychiatric Association defined Internet Gaming Disorder (IGD) as a tentative behavioral addiction in Section III in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* as a disorder that requires further research. Although cross-sectional studies have suggested that IGD is closely associated with poorer psychosocial well-being, longitudinal studies are scare, and whether poor psychosocial well-being is the cause or effect of IGD is still unclear. To address this issue, a longitudinal study including three-wave data from older-aged adolescents and emerging adults (1,054 first-year university students, age range 17–21 years, 41.2% male) was conducted. Cross-lagged panel models were computed to examine the longitudinal association between IGD and psychosocial well-being. The results suggested that IGD negatively affects variables of psychosocial well-being (i.e., self-esteem, social support, life satisfaction), but not vice versa. The results supported the *interpersonal impairment hypothesis*, which conceptualizes IGD as a maladaptive response leading to poorer psychosocial well-being. Furthermore, the results also showed that IGD was negatively associated with self-esteem and social support across all three waves with gender difference across these associations and larger correlations for males in comparison to females. In conclusion, the study findings highlight that the classification of IGD as a mental health disorder is appropriate, and that the condition is a risk factor for impaired psychosocial well-being in late adolescence and early adulthood.

Keywords: Internet Gaming Disorder, gaming addiction, problematic gaming, pathological gaming, psychosocial well-being

1. Introduction

The American Psychiatric Association (APA) defined Internet Gaming Disorder (IGD) as a tentative behavioral addiction in Section III in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) as a disorder that requires further research (American Psychiatric Association, 2013). More recently, the World Health Organization (WHO) formally recognized Gaming Disorder (GD) as a mental health disorder at the 72nd World Health Assembly (Pontes & Griffiths, 2020). Adolescence and emerging adulthood present with increased prevalence of IGD in Chinese university students (Long et al., 2018; Zhang, Wang, Shu, & Wu, 2019). Moreover, IGD associates with several detrimental psychological and well-being outcomes, such as depression (e.g., Gentile et al., 2011), anxiety (e.g., Wang et al., 2017), and loneliness (e.g., Lemmens, Valkenburg, & Peter, 2011). However, most of the existing evidence comes from cross-sectional research, which illustrates a lack of robust longitudinal research examining the association between IGD and psychosocial and well-being outcomes. Therefore, this study longitudinally investigated the interplay between psychosocial well-being indicators and IGD in a sample of Chinese first-year undergraduate students.

1.1 IGD and psychosocial well-being

Previous cross-sectional research has found that IGD is typically associated with poorer psychosocial well-being (e.g., Kochuchakkalackal & Reyes, 2019; Pontes, 2017) and several hypotheses have been put forward to explain this relationship. The *compensatory hypothesis* proposes that IGD may develop as a compensation mechanism for psychological problems

and poor psychosocial well-being (Kardefelt-Winther, 2014; Young, 1998). In this view, IGD may result from the need to escape from problems in daily life. Furthermore, the *interpersonal impairment hypothesis* views IGD as a maladaptive response to interpersonal stress rather than a pathology *per se* (Bischof-Kastner, Kuntsche, & Wolstein, 2014; Cheng, Cheung, & Wang, 2018). According to this perspective, IGD can lead to poorer psychosocial well-being. Despite these competing standpoints, longitudinal examination between IGD and psychosocial well-being outcomes is scarce, and there is little evidence supporting the aforementioned theoretical views.

1.2 Self-esteem

Self-esteem has been defined as an individual's self-assessment of their social role, and has the potential to affect behavioral outcomes (Rosenberg, Schooler, & Schoenbach, 1989). Low self-esteem is generally regarded as the foundation of negative behavioral outcomes, including internet use disorder (Fumero, Marrero, Voltes, & Peñate, 2018) and IGD (Beard, Haas, Wickham, & Stavropoulos, 2017). Previous cross-sectional research suggested that low self-esteem is associated with IGD (Kircaburun, Griffiths, & Billieux, 2019; Laconi, Pirès, & Chabrol, 2017; Lemmens, Valkenburg, & Gentile, 2015), particularly among male gamers (Ko, Yen, Chen, Chen, & Yen, 2005). A recent longitudinal study found that reduced self-esteem predicted IGD one year later in adolescents (e.g., Wartberg, Kriston, Zieglmeier, Lincoln, & Kammerl, 2019). However, a birth cohort study in Norway suggested that child self-esteem did not predict IGD symptoms (Wichstrøm, Stenseng, Belsky, von Soest, & Hygen, 2019).

1.3 Perceived social support

Perceived social support has been defined as a subjective feeling that an individual is cared for, assisted, and helped by other individuals (Zimet, Dahlem, Zimet, & Farley, 1988). Perceived social support can provide a buffer effect against many mental health problems. Individuals who lack social support in real life may compensate though gaming, which could lead to excessive usage (Davis, 2001). Thus, the *compensatory hypothesis* suggests that individuals may develop IGD due to a lack of social support in real life (e.g., Wartberg, Kriston, & Kammerl, 2017). Furthermore, previous cross-sectional studies (e.g., Festl, Scharkow, & Quandt, 2013; Yu, Mao, & Wu, 2018) reported negative associations between perceived social support and IGD. However, only one longitudinal study among Chinese university students found that social support did not predict IGD one year later (e.g., Zhang et al., 2019). To date, most of the previous research investigated the association between social support and generalized internet addiction (Lei, Li, Chiu, & Lu, 2018), and the relationship between perceived social support and IGD mainly cross-sectionally (e.g., Kaczmarek & Drążkowski, 2014), therefore, additional longitudinal research is necessary to further clarify this association.

1.4 Life satisfaction

Life satisfaction refers to how individuals evaluate their life as a whole, and it is an important dimension of subjective happiness and well-being (Diener, Emmons, Larsen, & Griffin, 1985). Previous cross-sectional research suggested a negative association between

life satisfaction and IGD (e.g., Festl et al., 2013; Reer, Festl, & Quandt, 2020). For instance, Mills, Li and Marchica (2019) found that life satisfaction negatively predicted IGD while Bargeron and Hormes (2017) reported that IGD associated with significantly lower levels of life satisfaction. However, two longitudinal studies indicated that life satisfaction did not statistically predict IGD six months later (Lemmens et al., 2011) or one year later (Peeters, Koning, & van den Eijnden, 2018). Given the relatively the lack of robust findings and contrasting evidence related to the potential associations between life satisfaction and IGD, further longitudinal examination of this relationship is also required to help clarify this issue.

1.5 The present study

The primary objective of this study was to examine the longitudinal association between IGD and psychosocial well-being (i.e., self-esteem, perceived social support, and life satisfaction) among older adolescents and emerging adults. To achieve this, cross-lagged panel models including relevant covariates (e.g., family income, parents' education levels), cross-sectional correlations between IGD and well-being, auto-regression and cross-lagged effects between IGD and well-being were examined. Since the longitudinal study of IGD and psychosocial well-being variables is scarce and the directionality of such relationships remain unknown, no specific hypothesis about directionality was developed. Moreover, because males are more likely to play video games and males with low self-esteem are at greater risk for developing IGD (e.g., Ko et al., 2005), gender differences were further investigated in the cross-lagged panel models.

Therefore, in order to further contribute to the field, this study aims to explore the

following two research questions: (1) Does psychosocial well-being predict IGD over time or vice versa? and (2) Are there significant gender differences in the longitudinal association between IGD and psychosocial well-being?

2 Methods

2.1 Participants and procedures

The sample comprised 1,054 first-year undergraduate students (17–21 years old, 41.2% male) recruited from a University in China. A cluster sampling method was employed to select a broad range of participants including those studying arts, science, technology, and agronomy. At the first time point (T1, October 2017) there were 1054 participants, at the second time point (T2, April 2018) there were 924 participants, and at the third time point (T3, October 2018) there were 931 participants. Across T1, T2, and T3, 269 participants had missing data (25.5% of total sample). Participants were the same as in a previous longitudinal study that explored associations between attachment and IGD (for more demographic information see [*blinded for peer-review*]).

Power analysis using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) was conducted to determine the ideal sample size. The correlation between IGD and psychosocial well-being has been found in previous research to be relatively small (r = -0.15 to -0.07, Cheng et al., 2018). Therefore, a sample size of 643 individuals has been suggested as ideal as it would allow the detection of correlations between IGD and psychosocial well-being of at least r = -0.11 at $p < 0.05$ level, with statistical power (1- β) of 80%.

All participants were informed of the aims of the study and that their data would only be used for research purposes. Study procedures were in accordance with the Declaration of Helsinki. The Institutional Review Board of [*blinded for peer-review*] approved this longitudinal study and all participants provided written informed consent to participate in the study.

2.2 Measures

2.2.1 Internet Gaming Disorder Scale-Short Form (IGDS9-SF)

Severity of IGD was assessed using the nine-item IGDS9-SF (Pontes & Griffiths, 2015) that is based on the DSM-5 IGD criteria. All nine items were assessed using a five-point Likert scale (1=*never* to 5=*very often*). The items were added to form a single composite total score, with higher scores indicating greater IGD severity. The Chinese version of IGDS9-SF was used to assess IGD symptoms in Chinese students (e.g., Yam et al., 2019; XX). In the present study, McDonald's ω coefficients for the IGDS9-SF were 0.88 (T1), 0.91 (T2), and 0.94 (T3), respectively.

2.2.2 Self-esteem

Participants completed the Chinese version of the nine-item Rosenberg Self-esteem Scale (Rosenberg et al., 1989; Tian, 2006). One item (‘‘*I wish I could have more respect for myself*’’) was deleted because previous research found it unsuitable for the Chinese culture (Tian, 2006). Participants responded to items using a four-point scale (1=*strongly disagree* to 4=*strongly agree*). McDonald's ω coefficients for this instrument were 0.85 (T1), 0.87 (T2),

and 0.88 (T3), respectively. The total score ranged from 9 to 36 points, with higher values reflecting higher self-esteem.

2.2.3 Social support

Social support was assessed using the 12-item Multidimensional Scale of Perceived Social Support (Zimet et al., 1988). The MSPSS assesses perceived social support from family, friends, and other relationships (e.g., teachers, classmates, relatives). Participants were asked to report the extent to which they agree with each item using a five-point Likert scale (1=*very strongly disagree* to 5=*very strongly agree*). Subscale scores were calculated by summing the obtained responses, with higher scores indicating greater levels of perceived social support. McDonald's ω coefficients for this instrument were 0.90 (T1), 0.93 (T2), and 0.93 (T3), respectively.

2.2.4 Life satisfaction

The Satisfaction with Life Scale (Diener et al., 1985) is the most widely used tool for assessing overall life satisfaction among Chinese students. This scale includes a total of five items rated on a five-point scale (1=*totally disagree* to 5=*totally agree*), with high scores indicating greater satisfaction with life. McDonald's ω coefficients for this instrument were 0.81 (T1), 0.84 (T2), and 0.88 (T3), respectively.

2.3 Data analysis

2.3.1 Missing data

From T1 to T3, 269 participants (25.5%) dropped out of the study. An indicator (0=*missing*, 1=*complete*) was created to examine whether missing data were conditional on any key variables. Male students were significantly missing ($\chi^2_{[1]} = 77.27$, $p < .01$), as were data relating to IGD ($t_{[389]} = 4.47$, $p < .01$) and social support ($t_{[426]} = 2.59$, $p = .01$). All other variables (age, self-esteem, and life satisfaction) were not significantly affected by missing data (all *p-values* > .05). Consequently, missing data were dealt with using the full-information maximum-likelihood (FIML) method in Mplus 7.10 (Muthén & Muthén, 2012). FIML generates unbiased and effective parameter estimates using complete data information (Graham, 2009).

2.3.2 Cross-lagged panel model

Three cross-lagged panel models were investigated to determine the relationship between IGD and psychosocial well-being variables (i.e., self-esteem, social support, and life satisfaction). In addition to calculating cross-sectional correlations between the main study variables, the analysis also included path stability coefficients from T1 to T2 and T2 to T3 (i.e., autoregressive path) and cross-lagged effects (see **Figure 1** for the path of β1, β2 and β3, β4). Family income and parental education levels at T1 were included as covariates in the models tested.

To assess the quality of the models tested, the Comparative Fit Index (CFI), Tucker-Lewis index (TLI), and the Root Mean Square Error of Approximation (RMSEA) were used to evaluate model fit. A CFI and TLI > 0.90, along with RMSEA<0.08, indicate adequate model fit (Hu & Bentler, 1999). Model parameters were selected using robust maximum

likelihood estimation (MLR), which can account for data non-normally distributed. In addition, 95% Confidence Intervals (CIs) were estimated for unstandardized coefficients. Path coefficients were considered statistically significant at $p<.05$. To examine potential gender differences, multiple-group analyses were conducted constraining coefficients to be equal across gender. Wald's χ^2 test was also computed to examine the specific path coefficient differences across gender (Muthén & Muthén, 2012).

3. Results

3.1 Preliminary analyses

Table 1 presents the means, standard deviations, and correlations among all variables of the study. Gender differences were found for life satisfaction ($F_{[1, 813]} = 4.61$, $p = .032$), social support ($F_{[1, 790]} = 139.38$, $p < .001$), and IGD ($F_{[1, 809]} = 240.73$, $p < .001$) but not for self-esteem. Overall, female participants scored higher on life satisfaction and social support and lower on IGD compared to male participants.

3.2 Main analyses

First, longitudinal measurement invariance was conducted, and then a cross-lagged panel model was used to examine the longitudinal relationship between IGD and psychosocial well-being to address the first research question (i.e., '*Does psychosocial well-being predict IGD over time or vice versa?*').

Table 2 presents the model fit for all five models tested for each psychosocial well-being outcome. The first three are the longitudinal measurement invariance models (e.g., configural invariance, weak invariance, and strong invariance models). The fourth model is a cross-lagged panel model which was based on a strong invariance model and included the Time 1 covariates (e.g., family income and parents' education level). The last model is a final constraint model which defined the path coefficients to be equal across time. All the model fits were acceptable, and a final constraint model for the path coefficients and stability was reported (see Table 3).

3.2.1 Self-esteem and IGD

The results indicated that IGD was a significant negative predictor of self-esteem from T1 to T2, β = −.06, 95% CIs [−.09, −.02] and T2 to T3, β = −.06, 95% CIs [−.10, −.02]. However, self-esteem did not significantly predict IGD from T1 to T2, β = −.03, 95% CIs [−.06, .01] or T2 to T3, β = −.03, 95% CIs [−.06, .01]. Additionally, stability paths and cross-sectional correlations were also statistically significant (all *p*-values < .01).

3.2.2 Perceived social support and IGD

The results indicated that IGD was a significant negative predictor of perceived social support from T1 to T2, β = −.08, 95% CIs [−.12, −.04]) and T2 to T3, β = −.10, 95% CIs [−.14, −.05]). However, perceived social support did not significantly predict IGD at either time point (T1 to T2: β = −.03, 95% CIs [−.07, .01]; T2 to T3: β = −.03, 95% CI [−.06, .01]). Additionally, stability path coefficients and cross-sectional correlations were also significant (all *p*-values <.01).

3.2.3 Life satisfaction and IGD

The results obtained demonstrate that IGD was as a negative predictor of life satisfaction from T1 to T2, β = −.09, 95% CIs [−.12, −.05]), and T2 to T3, β = −.10, 95% CIs [−.14, −.06]. However, life satisfaction did not significantly predict IGD (T1 to T2: β = −.03, 95% CIs [−.06, .01]; T2 to T3: β = −.02, 95% CI [−.06, .01]). Stability path coefficients were significant (all *p*-values <.01), but cross-sectional correlations between life satisfaction and IGD were not significant (see Table 3).

3.2.4 Gender differences

In order to address the second research question ('*Are there significant gender differences in the longitudinal association between IGD and psychosocial well-being?*'), multiple-group analyses were performed. For the self-esteem and IGD model, a significant gender difference was found ($\triangle\chi^2_{[11]} = 47.52$, $p<.001$). More specially, two paths were significantly different across gender: (i) autoregressive coefficient of self-esteem at T2 to T3; (ii) cross-lagged effect of T2 self-esteem on T3 IGD.

Furthermore, larger cross-sectional relationships both in T1, T2, and T3 were found in males. For the perceived social support and IGD model, multiple-group analysis indicated a significant gender difference ($\triangle\chi^2_{[11]} = 30.94$, $p = .001$). More specifically, cross-lagged effects of IGD on perceived social support (T1 to T2 and T2 to T3) were larger for males than females. Moreover, larger cross-sectional relationship between IGD and perceived social support were found for males than females at T1 and T2. Finally, for the life satisfaction and IGD model, no significant gender differences were observed in stability and cross-lagged paths ($\triangle\chi^2_{[8]} = 5.36$, $p = .718$). However, at T1, the cross-sectional correlation coefficient was larger for males than females. More information about the gender differences in these models can be seen in Table S1.

3.3 Additional analyses

For completeness, a combined single cross-lagged panel model that included self-esteem, social support, life satisfaction, and IGD was estimated. This model had adequate fit

($\chi^2_{[899]}$ = 1818.70, p <.001, CFI = .96, TLI = .95, RMSEA = .031, 90% CIs [.029, .033], SRMR = .075) and yielded the same results as individual cross-lagged panel models. More specifically, IGD was a negative predictor for all psychosocial well-being variables over time: self-esteem (T1 to T2: β = −.07, 95% CIs [−.10, −.03]; T2 to T3: β = −.08, 95% CIs [−.12, −.03]), social support (T1 to T2: β = −.10, 95% CIs [−.14, −.06]; T2 to T3: β = −.12, 95% CIs [−.16, −.07]), and life satisfaction (T1 to T2: β = −.10, 95% CIs [−.14, −.06]; T2 to T3: β = −.12, 95% CIs [−.16, −.08]). However, self-esteem, social support, and life satisfaction did not predict IGD both from T1 to T2 nor from T2 to T3 (See Table S2 for more details about the path coefficients obtained in this analysis).

4. Discussion

The present study examined the longitudinal association between psychosocial well-being and IGD using cross-lagged panel models. It was found that IGD negatively predicted subsequent psychosocial well-being outcomes (i.e., self-esteem, perceived social support, and life satisfaction), but well-being outcomes did not predict subsequent IGD. Overall, it was found that IGD negatively predicted self-esteem, perceived social support, and life satisfaction six months and one year later among Chinese first-year university students. These results provide support to and align with the *interpersonal impairment hypothesis* (e.g., Bischof-Kastner et al., 2014; Cheng et al., 2018) which posits that IGD precipitates poor interpersonal problems through decreased psychosocial well-being.

In addition to lending support to the *interpersonal impairment hypothesis*, the results encountered in this study suggest that IGD can prospectively lead to decreased well-being.

This finding is in line with previous longitudinal studies examining psychosocial health in adolescents. More specifically, Gentile et al. (2011) identified IGD as a predictor of anxiety, depression, and social phobia in adolescents two years later while Brunborg, Mentzoni, and Frøyland (2014) found that IGD was linked with greater levels of depression, poorer academic achievement, and conduct problems two years later. Taken together, the results suggest that IGD can uniquely contribute to long-term decreased well-being and mental health effects among adolescents and young adults.

Furthermore, male participants exhibited larger cross-sectional correlations between IGD and psychosocial well-being outcomes than female participants, especially at T1. This gender difference is in line with previous research (Ko et al., 2005) showing that males present with significantly higher negative associations between psychosocial factors (e.g., self-esteem and life satisfaction) and IGD compared to females.

The implication of the findings obtained is that IGD may, as a disorder, lead to lower levels of self-esteem, which is consistent with previous studies in the field (e.g., Lemmens et al., 2011; Toker & Baturay, 2016), making it a potential consequence of IGD. Conversely, the present findings also showed that self-esteem did not predict subsequent IGD, which is not aligned with previous longitudinal research suggesting that low self-esteem is a predictor of IGD (e.g., Lemmens et al., 2011; Wartberg et al., 2019). The discrepancy between studies may be due to age differences in the participants recruited as both previous studies included younger participants (i.e., 11–17 years, Lemmens et al., 2011; 12–14 years, Wartberg et al., 2019) than the present study (i.e., 17-21 years). Future developmental studies should test these associations on a wider sample of adolescents.

The findings also indicated that early IGD negatively predicted later perceived social support, but not vice versa. This is a novel finding providing longitudinal evidence that IGD may lead to decreased social support. It also contributes to extending previous similar findings reported in cross-sectional research (e.g., Festl et al., 2013; Yu et al., 2018).

The results of the present study also showed that IGD was a negative predictor of life satisfaction, even though life satisfaction did not predict IGD. This outcome implies that disordered gamers feel less satisfied with their daily lives, and that they may not necessarily develop IGD due to lower life satisfaction. This finding corroborates and extends previous cross-sectional research suggesting that higher levels of IGD are associated with lower perceived life satisfaction among adolescents and older adults (Festl et al., 2013). Notwithstanding this, the results are also in line with a longitudinal study demonstrating that IGD negatively predicted life satisfaction in adults over 40 years old (Scharkow, Festl, & Quandt, 2014). Overall, these data support the uses and gratifications theory (e.g., Li, Liu, Xu, Heikkilä, & Van Der Heijden, 2015), which posits that IGD leads to lower life satisfaction.

This study presents with several potential limitations that should be considered when interpreting the findings reported. First, the self-report data common to many longitudinal studies are subject to shared-method variance and psychological biases, such as social desirability and memory recall bias. However, the cross-lagged panel models used partially mitigated such effects by controlling for initial correlations and covariation. Future research aiming at examining how IGD affects psychosocial well-being should consider combining various data collection methods, such as teacher or parent ratings and expert evaluation.

Second, the cross-lagged models investigated only included between-individual variance for IGD and well-being. However, as noted by Hamaker, Kuiper, and Grasman (2015), cross-lagged models may not necessarily represent actual within-individual relationships over time. Therefore, it is recommended that multilevel models are used to separate between- and within-individual effects (e.g., Curran & Bauer, 2011). Third, the longitudinal study only lasted one year, a period that may be too short to fully explore the broad extent of developmental effects of IGD on psychosocial well-being. Therefore, future studies should increase their length for a better understanding of transition patterns from early to late adolescence. Finally, only the direct relationship between well-being and IGD was examined. However, as suggested in the syndemic-syndaimonic continuum hypothesis (Snodgrass, Lacy, & Cole, 2019), well-being may interact with IGD to impact on health. Future research should not only examine the longitudinal association between IGD and well-being, but also investigate the interaction between these variables on the long-term effects on human health.

In conclusion, the results obtained provide support for the interpersonal impairment hypothesis which conceptualizes IGD as a maladaptive response leading to poorer psychosocial well-being. This finding has potential to improve initial assessment of IGD and help treatment efforts to be more focused on IGD at the early stages of the treatment. Besides, appropriate prevention measures are increasingly necessary because IGD incidence continues to increase globally, leading several countries to implement large-scale school-based prevention programs that include IGD in their curricula, such as Positive Adolescent Training through Holistic Social (P.A.T.H.S.) program (see Busiol & Lee, 2015).

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*. Arlington, VA: American Psychiatric Publishing.

Bargeron, A. H., & Hormes, J. M. (2017). Psychosocial correlates of Internet gaming disorder: Psychopathology, life satisfaction, and impulsivity. *Computers in Human Behavior, 68*, 388−394. https://doi.org/10.1016/j.chb.2016.11.029

Beard, C. L., Haas, A. L., Wickham, R. E., & Stavropoulos, V. (2017). Age of initiation and internet gaming disorder: The role of self-esteem. *Cyberpsychology, Behavior, and Social Networking, 20*(6), 397−401. https://doi.org/10.1089/cyber.2017.0011

Bischof-Kastner, C., Kuntsche, E., & Wolstein, J. (2014). Identifying problematic Internet users: development and validation of the Internet Motive Questionnaire for Adolescents (IMQ-A). *Journal of Medical Internet Research, 16*(10), e230. https://doi.org/10.2196/jmir.3398

Brunborg, G. S., Mentzoni, R. A., & Frøyland, L. R. (2014). Is video gaming, or video game addiction, associated with depression, academic achievement, heavy episodic drinking, or conduct problems? *Journal of Behavioral Addictions, 3*(1), 27-32. doi:10.1556/JBA.3.2014.002

Busiol, D., & Lee, T. Y. (2015). Prevention of internet addiction: the PATHS program. *In Student well-being in Chinese adolescents in Hong Kong* (pp. 185-193). Springer, Singapore.

Cheng, C., Cheung, M. W. L., & Wang, H. Y. (2018). Multinational comparison of internet gaming disorder and psychosocial problems versus well-being: Meta-analysis of 20

countries. *Computers in Human Behavior, 88*, 153−167. https://doi.org/10.1016/j.chb.2018.06.033

Curran, P. J., & Bauer, D. J. (2011). The disaggregation of within-person and between-person effects in longitudinal models of change. *Annual Review of Psychology, 62*, 583−619. https://doi.org/10.1146/annurev.psych.093008.100356

Davis, R. A. (2001). A cognitive-behavioral model of pathological Internet use. *Computers in Human Behavior, 17*(2), 187−195. https://doi.org/10.1016/S0747-5632(00)00041-8

Diener, E. D., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment, 49*, 71−75. https://doi.org/10.1207/s15327752jpa4901_13

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. Behavior research methods, 41(4), 1149-1160. https://doi.org/10.3758/BRM.41.4.1149

Festl, R., Scharkow, M., & Quandt, T. (2013). Problematic computer game use among adolescents, younger and older adults. *Addiction, 108*(3), 592−599. https://doi.org/10.1111/add.12016

Fumero, A., Marrero, R. J., Voltes, D., & Peñate, W. (2018). Personal and social factors involved in internet addiction among adolescents: A meta-analysis. *Computers in Human Behavior, 86*, 387−400. https://doi.org/10.1016/j.chb.2018.05.005

Gentile, D. A., Choo, H., Liau, A., Sim, T., Li, D., Fung, D., & Khoo, A. (2011). Pathological video game use among youths: A two-year longitudinal study. *Pediatrics, 127*(2), e319−e329. https://doi.org/10.1542/peds.2010-1353

Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology, 60*, 549−576. https://doi.org/10.1146/annurev.psych.58.110405.085530

Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods, 20*, 102−116. https://doi.org/10.1037/a0038889

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1−55. https://doi.org/10.1080/10705519909540118

Kaczmarek, L. D., & Drążkowski, D. (2014). MMORPG escapism predicts decreased well-being: Examination of gaming time, game realism beliefs, and online social support for offline problems. *Cyberpsychology, Behavior, and Social Networking, 17*(5), 298-302. doi:10.1089/cyber.2013.0595

Kardefelt-Winther, D. (2014). Problematizing excessive online gaming and its psychological predictors. *Computers in Human Behavior, 31*, 118−122. https://doi.org/10.1016/j.chb.2013.10.017

Kircaburun, K., Griffiths, M. D., & Billieux, J. (2019). Psychosocial factors mediating the relationship between childhood emotional trauma and internet gaming disorder: A pilot study. *European Journal of Psychotraumatology, 10*(1), 1565031. https://doi.org/10.1080/20008198.2018.1565031

Ko, C. H., Yen, J. Y., Chen, C. C., Chen, S. H., & Yen, C. F. (2005). Proposed diagnostic criteria of Internet addiction for adolescents. *Journal of Nervous and Mental Disease, 193*(11), 728−733. https://doi.org/10.1097/01.nmd.0000185891.13719.54

Kochuchakkalackal, G. K., & Reyes, M. E. S. (2019). Compulsive internet gaming and its relationship with poor psychological well-being among selected adolescents. *Journal of Technology in Behavioral Science, 4*(4), 303-308. doi:10.1007/s41347-019-00098-7

Laconi, S., Pirès, S., & Chabrol, H. (2017). Internet gaming disorder, motives, game genres and psychopathology. *Computers in Human Behavior, 75*, 652−659. https://doi.org/10.1016/j.chb.2017.06.012

Lei, H., Li, S., Chiu, M. M., & Lu, M. (2018). Social support and Internet addiction among mainland Chinese teenagers and young adults: A meta-analysis. *Computers in Human Behavior, 85*, 200−209. https://doi.org/10.1016/j.chb.2018.03.041

Lemmens, J. S., Valkenburg, P. M., & Gentile, D. A. (2015). The Internet Gaming Disorder Scale. *Psychological Assessment, 27*, 567−582. https://doi.org/10.1037/pas0000062

Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2011). Psychosocial causes and consequences of pathological gaming. *Computers in Human Behavior, 27*, 144−152. https://doi.org/10.1016/j.chb.2010.07.015

Li, H., Liu, Y., Xu, X., Heikkilä, J., & Van Der Heijden, H. (2015). Modeling hedonic is continuance through the uses and gratifications theory: An empirical study in online games. *Computers in Human Behavior, 48*, 261−272. https://doi.org/10.1016/j.chb.2015.01.053

Long, J., Liu, T., Liu, Y., Hao, W., Maurage, P., & Billieux, J. (2018). Prevalence and correlates of problematic online gaming: A systematic review of the evidence published in Chinese. *Current Addiction Reports, 5*(3), 359−371. https://doi.org/10.1007/s40429-018-0219-6

Mills, D. J., Li, W., & Marchica, L. (2019). Negative affect, life satisfaction, and Internet gaming disorder: Exploring the mediating effect of coping and the moderating effect of passion. *World Journal of Social Science Research, 6*(1), 47−66. https://doi.org/10.22158/wjssr.v6n1p45

Muthén, L. K., & Muthén, B. O. (2012). *MPlus: Statistical analysis with latent variables--User's guide.* Los Angeles, CA: Muthén & Muthén.

Peeters, M., Koning, I., & van den Eijnden, R. (2018). Predicting Internet gaming disorder symptoms in young adolescents: A one-year follow-up study. *Computers in Human Behavior, 80*, 255−261. https://doi.org/10.1016/j.chb.2017.11.008

Pontes, H. M. (2017). Investigating the differential effects of social networking site addiction and Internet gaming disorder on psychological health. *Journal of Behavioral Addictions, 6*(4), 601-610. https://doi.org/10.1556/2006.6.2017.075

Pontes, H. M., & Griffiths, M. D. (2015). Measuring DSM-5 Internet gaming disorder: Development and validation of a short psychometric scale. *Computers in Human Behavior, 45*, 137−143. https://doi.org/10.1016/j.chb.2014.12.006

Pontes, H. M., & Griffiths, M. D. (2020). A new era for gaming disorder research: Time to shift from consensus to consistency. *Addictive Behaviors, 103,* 106059. https://doi.org/10.1016/j.addbeh.2019.106059

Reer, F., Festl, R., & Quandt, T. (2020). Investigating problematic social media and game use in a nationally representative sample of adolescents and younger adults. *Behaviour & Information Technology*, 1-14. doi:10.1080/0144929X.2020.1724333

Rosenberg, M., Schooler, C., & Schoenbach, C. (1989). Self-esteem and adolescent

problems: Modeling reciprocal effects. *American Sociological Review, 54*, 1004−1018. https://doi.org/10.2307/2095720

Scharkow, M., Festl, R., & Quandt, T. (2014). Longitudinal patterns of problematic computer game use among adolescents and adults—A 2-year panel study. *Addiction, 109*, 1910−1917. https://doi.org/10.1111/add.12662

Snodgrass, J. G., Lacy, M. G., & Cole, S. W. (2019). Internet gaming, embodied distress, and psychosocial well-being: A syndemic-syndaimonic continuum. *Social Science & Medicine*, 112728. https://doi.org/10.1016/j.socscimed.2019.112728

Tian, L. M. (2006). Shortcoming and merits of Chinese version of Rosenberg (1965) self-esteem scale. *Psychological Exploration, 26*(2), 88−91.

Toker, S., & Baturay, M. H. (2016). Antecedents and consequences of game addiction. *Computers in Human Behavior, 55*, 668−679. https://doi.org/10.1016/j.chb.2015.10.002

Wang, C. Y., Wu, Y. C., Su, C. H., Lin, P. C., Ko, C. H., & Yen, J. Y. (2017). Association between Internet gaming disorder and generalized anxiety disorder. *Journal of Behavioral Addictions, 6*(4), 564−571. https://doi.org/10.1556/2006.6.2017.088

Wartberg, L., Kriston, L., & Kammerl, R. (2017). Associations of social support, friends only known through the internet, and health-related quality of life with internet gaming disorder in adolescence. *Cyberpsychology, Behavior, and Social Networking, 20*(7), 436-441. https://doi.org/10.1089/cyber.2016.0535

Wartberg, L., Kriston, L., Zieglmeier, M., Lincoln, T., & Kammerl, R. (2019). A longitudinal study on psychosocial causes and consequences of Internet gaming disorder in adolescence. *Psychological Medicine, 49*, 287−294.

https://doi.org/10.1017/S003329171800082X

Wichstrøm, L., Stenseng, F., Belsky, J., von Soest, T., & Hygen, B. W. (2019). Symptoms of Internet gaming disorder in youth: Predictors and comorbidity. *Journal of Abnormal Child Psychology, 47*(1), 71−83. https://doi.org/10.1007/s10802-018-0422-x

Yam, C. W., Pakpour, A. H., Griffiths, M. D., Yau, W. Y., Lo, C. L. M., Ng, J. M., ... & Leung, H. (2019). Psychometric testing of three Chinese online-related addictive behavior instruments among Hong Kong university students. *Psychiatric Quarterly, 90*(1), 117−128. https://doi.org/10.1007/s11126-018-9610-7

Young, K. S. (1998). Internet addiction: The emergence of a new clinical disorder. *CyberPsychology & Behavior, 1*(3), 237−244. https://doi.org/10.1089/cpb.1998.1.237

Yu, S., Mao, S., & Wu, A. M. (2018). The interplay among stress, frustration tolerance, mindfulness, and social support in Internet gaming disorder symptoms among Chinese working adults. *Asia-Pacific Psychiatry, 10*(4), e12319. https://doi.org/10.1111/appy.12319

Zhang, M. X., Wang, X., Shu, M. Y., & Wu, A. M. (2019). Purpose in life, social support, and internet gaming disorder among Chinese university students: A 1-year follow-up study. *Addictive Behaviors, 99*, 106070. https://doi.org/10.1016/j.addbeh.2019.106070

Zimet, G. D., Dahlem, N. W., Zimet, S. G., & Farley, G. K. (1988). The multidimensional scale of perceived social support. *Journal of Personality Assessment, 52*, 30−41. https://doi.org/10.1207/s15327752jpa5201_2

Table 1

Correlations between Internet Gaming Disorder (IGD) and psychological well-being at three time points.

	1	2	3	4	5	6	7	8	9	10	11	12
1. IGD (T1)	-											
2. IGD (T2)	0.56**	-										
3. IGD (T3)	0.49**	0.57**	-									
4. Self-esteem (T1)	-0.17**	-0.12**	-0.04*	-								
5. Self-esteem (T2)	-0.17**	-0.28**	-0.18**	0.52**	-							
6. Self-esteem (T3)	-0.15**	-0.19**	-0.31**	0.42**	0.59**	-						
7. Social support (T1)	-0.22**	-0.14**	-0.11**	0.35**	0.28**	0.30**	-					
8. Social support (T2)	-0.18**	-.25**	-0.14**	0.25**	0.47**	0.34**	0.53**	-				
9. Social support (T3)	-0.19**	-0.19**	-0.28**	0.27**	0.34**	0.56**	0.47**	0.57**	-			
10. Life satisfaction (T1)	-.080**	-0.06	-0.06	0.48**	0.34**	0.30**	0.41**	0.32**	0.32**	-		
11. Life satisfaction (T2)	-0.10**	-0.07*	-0.05	0.31**	0.52**	0.35**	0.32**	0.44**	0.31**	0.57**	-	
12. Life satisfaction (T3)	-0.13**	-.12**	-0.10**	0.26**	0.39**	0.52**	0.28**	0.30**	0.47**	0.46**	0.57**	-
Mean	1.47	1.62	1.69	3.19	3.03	3.05	4.01	4.00	3.95	4.24	4.39	4.44
Standard Deviation	0.57	0.67	0.77	0.36	0.46	0.48	0.59	0.61	0.64	1.08	1.09	1.15

Note: *$p < .05$; ** $p < .01$. IGD = Internet Gaming Disorder.

Table 2

Model fits for the cross-lagged panel models between Internet Gaming Disorder (IGD) and psychological well-being outcomes.

Model	χ^2 (*df*)	*P*	ΔCFI	ΔTLI	RMSEA [90% CIs]	CFI	TLI	SRMR
IGD and self-esteem								
1. Configural invariance model	190.61 (102)	<0.001	–	–	0.029 [0.022, 0.035]	0.990	0.986	0.028
2. Weak invariance model	217.37 (110)	<0.001	0.002	0.002	0.030 [0.024, 0.036]	0.988	0.984	0.042
3. Strong invariance model	495.57 (122)	<0.001	0.029	0.035	0.054 [0.049, 0.054]	0.959	0.949	0.074
4. Cross-lagged panel model	399.07 (150)	<0.001	0.015	0.022	0.040 [0.035, 0.044]	0.974	0.967	0.055
5. Final constraint model	413.50 (156)	<0.001	0.001	0.001	0.040 [0.035, 0.044]	0.973	0.968	0.060
IGD and social support								
6. Configural invariance model	105.63 (102)	0.383	–	–	0.006 [0.000, 0.017]	0.999	0.999	0.016
7. Weak factorial invariance model	122.81 (110)	0.190	0.001	0.002	0.011 [0.000, 0.020]	0.998	0.997	0.021
8. Strong factorial invariance model	270.70 (122)	<0.001	0.019	0.023	0.034 [0.029, 0.039]	0.979	0.974	0.049
9. Cross-lagged panel model	277.72 (150)	<0.001	0.005	0.005	0.028 [0.023, 0.034]	0.984	0.979	0.043
10. Final constraint model	279.53 (156)	<0.001	0.000	0.002	0.027 [0.022, 0.023]	0.984	0.981	0.045
IGD and life satisfaction								
11. Configural invariance model	341.51 (213)	<0.001	–	–	0.024 [0.019, 0.029]	0.989	0.986	0.028
12. Weak invariance model	364.72 (225)	<0.001	0.001	0.001	0.024 [0.020, 0.029]	0.988	0.985	0.030
13. Strong invariance model	588.46 (241)	<0.001	0.018	0.020	0.037 [0.033, 0.041]	0.970	0.965	0.047
14. Cross-lagged panel model	694.40 (281)	<0.001	0.004	0.005	0.037 [0.034, 0.041]	0.966	0.960	0.045
15. Final constraint model	699.16 (287)	<0.001	0.000	0.001	0.037 [0.033, 0.040]	0.966	0.961	0.048

Note: Each model was compared with the last model (e.g., Model 5 were compared with Model 4). The final constraint model was defined the path coefficients to be equal across time. IGD = Internet Gaming Disorder.

Table 3

Cross-lagged path analyses of psychological well-being and Internet Gaming Disorder (IGD).

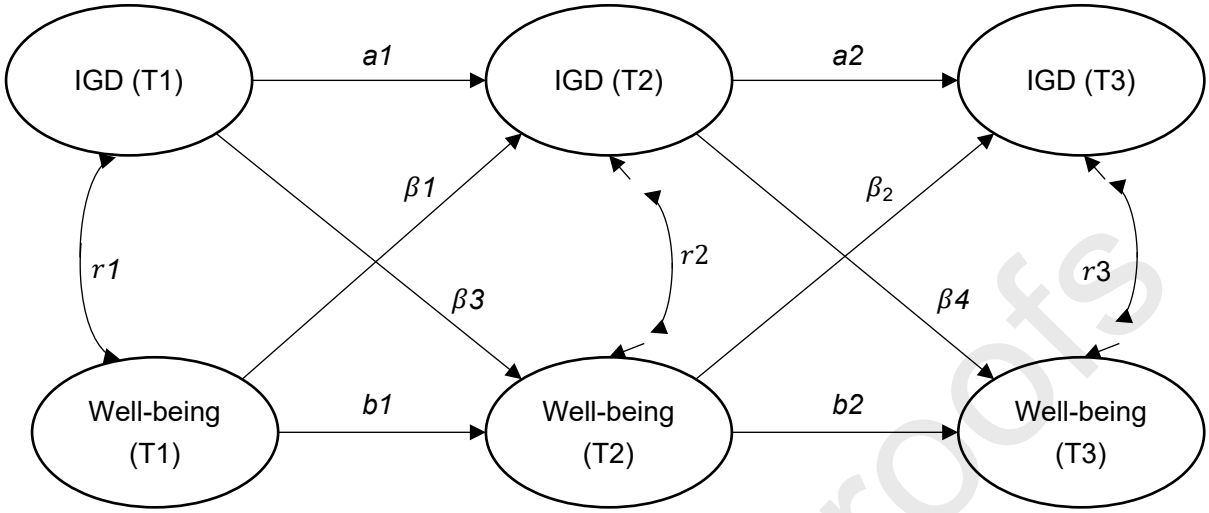
Psychological well-being	Self-esteem		Social support		Life satisfaction	
	b (SE)	β	*b* (SE)	β	*b* (SE)	β
Covariates						
Parental education → Well-being (T2)	−.02 (.01)	−.05	.01 (.02)	.01	.02 (.03)	.02
Family incomes →Well-being (T2)	−.03 (.01)	−.08**	−.01 (.02)	−.02	.02 (.03)	.03
Parental education → IGD (T2)	.01 (.02)	.02	.01 (.02)	.02	.01 (.02)	.02
Family incomes → IGD (T2)	.04 (.02)	.07*	.04 (.02)	.07*	.04 (.02)	.07*
Parental education →Well-being (T3)	−.03 (.02)	−.06	−.02 (.02)	−.04	.04 (.03)	.04
Family incomes →Well-being (T3)	.02 (.01)	.05	.01 (.02)	.03	.01 (.02)	.01
Parental education → IGD (T3)	.01 (.02)	.01	.01 (.02)	.02	.01 (.02)	.02
Family incomes → IGD (T3)	.02 (.02)	.04	.01 (.02)	.04	.01 (.02)	.04
Stability paths						
IGD (T1) → IGD (T2)	.75 (.04)	.62**	.75 (.04)	.61**	.75 (.04)	.63**
IGD (T2) → IGD (T3)	.75 (.04)	.64**	.75 (.04)	.63**	.75 (.04)	.63**
Well-being (T1) → Well-being (T2)	.75 (0.03)	.60**	.62 (.03)	.56**	.67 (.03)	.62**
Well-being (T2) → Well-being (T3)	.75 (0.03)	.68**	.62 (.03)	.61**	.67 (.03)	.64**
Cross-sectional correlations						
IGD (T1) ↔ Well-being (T1)	−.05 (.01)	−.26**	−.06 (.01)	−.23**	−.02 (.01)	−.04
IGD (T2) ↔ Well-being (T2)	−.05 (.01)	−.28**	−.06 (.01)	−.27**	−.02 (.01)	−.05
IGD (T3) ↔ Well-being (T3)	−.05 (.01)	−.25**	−.06 (.01)	−.25**	−.02 (.01)	−.04
Cross-lagged effects						
IGD (T1) → Well-being (T2)	−.04 (.02)	**−.06***	−.09 (.03)	**−.08****	−.18 (.04)	**−.09****
IGD (T2) →Well-being (T3)	−.04 (.02)	**−.06***	−.09 (.03)	**−.10****	−.18 (.04)	**−.10****
Well-being (T1) → IGD (T2)	−.05 (.04)	−.03	−.03 (.03)	−.03	−.02 (.01)	−.03
Well-being (T2) → IGD (T3)	−.05 (.04)	−.03	−.03 (.03)	−.02	−.02 (.01)	−.02

Note. IGD=Internet Gaming Disorder, T1=Time 1, T2=Time 2, T3=Time 3.

* $p<.05$;

**$p<.01$.

Figure 1. The cross-lagged effect of IGD and psychosocial well-being outcomes.



Note. IGD = Internet Gaming Disorder.

Author Agreement Statement

We the undersigned declare that this manuscript [**Internet Gaming Disorder and Psychosocial Well-being: A Longitudinal Study of Chinese Older-aged Adolescents and Emerging Adults.**] is original, has not been published before and is not currently being considered for publication elsewhere.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We understand that the Corresponding Author is the sole contact for the Editorial process. He is responsible for communicating with the other authors about progress, submissions of

revisions and final approval of proofs.

Signed by all authors as follows:

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Author Statement

Zhaojun Teng and Cheng Guo contributed to design the study.

Halley M. Pontes and Mark D Griffiths contributed to writing of the paper and its revision.

Zhaojun Teng and Qian Nie contributed to literature review.

Zhaojun Teng and Guangcan Xiang contributed to data collection and statistical analysis.

Zhaojun Teng and Cheng Guo provided found to conduct the study.

All authors contributed to and have approved the final version of the manuscript.

Conflict of Interest Statement:

The authors declare no conflict of interest.

Highlights

- A longitudinal study explored the bidirectional relationships between internet gaming disorder and wellbeing outcomes.
- Internet Gaming Disorder was weakly predicted the later well-being, but not inverse.
- The classification of IGD as a mental health disorder is valid.